

REMARKS FOR ADMINISTRATOR BOLDEN

JOHN H. GLENN LECTURE IN SPACE HISTORY

**"NASA's Legacy and Future: Personal Reflections of a
Space Flyer"**

June 27, 2012

Thank you, General Dailey. It's always a pleasure to be here at the Smithsonian's National Air and Space Museum, home to so many artifacts of our nation's leadership in space. It's a living history, because we continue to innovate and reach for farther horizons.

I'm also delighted to speak at a lecture honoring my esteemed colleague, Senator John Glenn, who just last month was recognized with a well-deserved Presidential Medal of Freedom for his extraordinary service to our country.

When John first flew, he not only undertook a dangerous mission, he personified America's dreams -- what we believed we could be

-- through his unflappable nature and his confidence. He helped us believe in what we could achieve.

I know that right here in this very theater, this museum showed live launch coverage of John's second historic flight, back in 1998, on the space shuttle Discovery, as he once again made history, this time as the oldest person to fly in space.

We're going to continue building on John's legacy as we reach toward new destinations and build new capabilities for exploration.

Just a month ago at this time, the *Dragon* capsule was making history as the first space vehicle built by a private company not intended specifically for government purchase to visit the International Space Station.

There are many more exciting days ahead not only in commercial space, but as NASA continues to launch science missions that rewrite history, develop cutting edge aeronautics technologies, and build the rocket and crew vehicle that will take astronauts to an asteroid, Mars, and perhaps other deep space destinations.

Back in April, we transferred to the Smithsonian the space shuttle *Discovery* on which John flew, while its sister ship, *Enterprise*, went to New York City's Intrepid Sea, Air & Space Museum.

We're delighted to share the achievements of the Space Shuttle Program with millions of visitors, many of whom will doubtless become the exploration leaders of tomorrow. At the same time, we are very attached to this fleet of vehicles, probably the most amazing machines ever built, on which we've flown millions of miles and accomplished so much. So in a way, as a fellow flyer aboard *Discovery*, I feel like part of me is on permanent display out at the Udvar-Hazy Center as well. That's a good thing!

The shuttle gave our nation many firsts – many proud moments. I was fortunate to fly on it four times and be part of two historic achievements aboard *Discovery*: the deployment of the Hubble Space Telescope on STS-31 in 1990, which has redefined our perception of the universe; and the first U.S./Russian shuttle mission, STS-60 in 1994 – that presaged the unprecedented international cooperation we've achieved since on the International Space Station.

I also flew on *Columbia* and *Atlantis*. *Atlantis* joined *Discovery* and *Endeavour*, as the transport for the subsequent servicing missions to Hubble that extended this unique resource and enhanced the Great Observatory's capabilities.

Among those many historic achievements of the shuttle was deployment of the *Chandra* X-ray Observatory that, among other things, documented the largest supernova ever witnessed.

The shuttle also deployed the *Magellan* probe to Venus. Many of the Tracking and Data Relay, or TDRS, satellites were also deployed from the shuttle. NASA uses these satellites to maintain contact with the space station, and other government agencies also use them for satellite communication.

We also deployed communications satellites for many other countries from shuttle.

STS 41-C brought us the capture and repair of the *Solar Maximum* satellite, the first repair of a satellite on orbit. And of course, we constructed one of the world's true engineering marvels, the Space Station itself, using the shuttle.

The shuttle program also taught us hard lessons. The tragic losses of the *Challenger* and *Columbia* crews, were extraordinarily painful for the nation and for those of us who knew these brave explorers personally.

Space travel is hard and unforgiving. It always has been and always will be. There's never going to be zero risk. When you're breaking the bonds of gravity, that's just part of the deal.

But tonight, I want to talk about my own recollections as a traveler to space, and perhaps reflect on the greater significance of the space program to our nation and the world, some of the momentous things we've accomplished, and where we're headed next.

I have to tell you that space was never really in my sights as a youngster. I wasn't one of those kids who dreamed of being an astronaut, even though John Glenn and the Mercury 7 and later the Gemini and Apollo astronauts were doing amazing things -- the stuff that was discussed at dinner tables and water coolers as well as in the halls of power.

I was focused on public service, however. I wanted to join the military and serve as my father and uncles had done in World War II. They served with distinction but not always recognition, because of their race. It was a different world back then in segregated South Carolina, and the thought that I would be the first African American Administrator of our nation's space program under the nation's first Black president would have seemed as much science fiction as the idea that an orbiting outpost with a football field's worth of solar arrays would have had people living and working aboard it continuously – from Russia, the U.S. and many other nations -- for more than 11 years now.

But the future doesn't always wait for us to embrace it, does it? It's coming at us, and we can certainly try to prepare for our involvement, but the momentum is always there. Today, we're at a once-in-a-generation turning point.

It may be even bigger than that, as we transition from a phenomenal 30-year flagship program in the Space Shuttle to an entirely new way of doing business.

It's particularly exciting for us to really be focusing on the technologies that the aerospace field has broadly agreed for years we would need to get farther in the solar system. It's not overstating it so say that right now we're opening a new chapter in the space age.

NASA's role has historically been crucial in seeding the technology and innovations that brought our nation's capabilities to the cutting-edge, made America the world's leader in space exploration, and made a difference in our everyday lives. The Agency's impact on our nation's technological future, the workforce and the economy are based on investments and innovations that we had the courage to make.

Today, our Space Technology Program has about 1000 projects developing the technologies we need for tomorrow's missions. In the nation's laboratories and test chambers, NASA is driving advances in new high-payoff space technologies and developing and maturing broadly applicable technology in areas such as: in-space propulsion, robotics, space power systems, deep-space communications, cryogenic fluid handling, and entry, descent, and landing, which are essential for exploration beyond low Earth orbit. When we invest in technology for space, we spend that money right here on earth, creating the high-tech jobs, capabilities, and products that help our nation maintain its global economic leadership.

As part of that focus on the future, we're also building a rocket that will take astronauts deeper into space than ever before.

Orion, the vehicle in which they'll travel, has undergone water tests, parachute drop tests, and a lot of work on its thermal protection material. We plan a test flight in 2014.

This chart shows the relative sizes of the Saturn V, the shuttle, and our new rocket in two different configurations. So you can see, we are going for something quite new and spectacular.

At the same time, we've reached a point where we can turn over the path to low Earth orbit that the government pioneered to our private industry partners. This will allow NASA to focus on those farther horizons we want to reach. Vehicles with names like *Dragon*, *Dream Chaser*, and *Cygnus* are at the vanguard of this new innovative push by industry.

Our science missions are working in partnership with exploration so the things we learn will support future missions with astronauts.

The *Dawn* mission has recently visited the asteroid Vesta, for instance -- the first time we've orbited one of those ancient rocks -
- and it sent us a lot of surprising data that we'll take into account as we work toward a human mission to an asteroid.

As we review our Mars program, we'll be looking at ways that science and exploration can work together to make the most of our missions so that we continue to make discoveries that rewrite textbooks while supporting the first human boots on the Red Planet.

NASA has been blessed throughout its life with support from across the political spectrum. There's something about exploration that crosses political boundaries just as surely as those disappear when the Earth is seen from above.

The public support -- not only in dollars, but also in attitudes, in willingness to believe in something that seemed almost impossible -- that was a big part of what made space travel possible. With the leadership of President Kennedy and a courageous corps of space pioneers like John Glenn, it became something we HAD TO do as a nation.

The Cold War was a motivator of course, but I believe we still would have explored without it. We were on the cusp of so many technological developments and discoveries. Our robotic probes like *Explorer*, *Ranger*, and *Mariner* were revolutionizing our understanding of outer space, the moon, Mars, and Venus even as John and the rest of the astronauts made history as the first humans in space. I might note that a replica of *Explorer 1*, our first satellite, is hanging outside this theater in the Milestones of Flight Gallery. A replica of *Ranger* hangs on the east side of the museum and an engineering model of the *Surveyor* moon lander hangs near that.

NASA was also busy pioneering the technologies needed for whole new industries and services at that time and then handing those capabilities on to commercial companies, much as we are doing now with commercial space flight. Communications satellites like *Echo*, for instance, helped lead to commercial satellites, and meteorology satellites like *Tiros* led to the series currently operated by NOAA.

Then of course, the Apollo missions tested spacecraft in Earth and moon orbit and visited the moon 6 times, studying soil mechanics, meteoroids, and questions about seismic activity, heat flow, magnetic fields and solar wind. Even when an oxygen tank explosion forced *Apollo 13* to scrub its lunar landing, the "can-do" problem-solving attitude of the crew and mission control turned the mission into a "successful failure."

Today, the International Space Station continues as the core of our human spaceflight efforts.

An amazing showcase for human ingenuity, and a unique scientific resource like no other the world has ever seen, it's going to help us understand a lot of the human health issues we'll need to get our arms around before traveling farther into space. It will also allow us to demonstrate some of the technologies that we'll need. Now that it's complete, we're ramping up our utilization by many different types of groups, from other government agencies, to academia, and industry.

Led by the U.S. in partnership with Russian, Japanese, European and Canadian partners, the ISS is the most complex space facility ever built. It carries almost a million pounds of hardware, spans more than the length of a football field and has an interior volume greater than a 747. It travels 17,500 miles per hour, orbiting the

Earth 16 times a day with an international crew of 6 actively participating in over 100 research investigations at any given time.

Every research investigation and all of the systems that keep the ISS operational helps us figure out how to improve life here on Earth as we prepare to explore farther from our planet.

Effective reliance on solar power and onboard water processing are two examples of how we are learning to better operate a spacecraft independent of resources resupplied from Earth.

Developing these necessities for living and working onboard the ISS is enabling us to figure out how to better use renewable resources on Earth and how to do things like provide clean water to people living in underdeveloped countries.

Now, when I graduated from the Naval Academy, we were on the cusp of landing humans on the moon. A lot of my colleagues,

naval aviators, went on to pursue careers with NASA, but it still wasn't on my radar, so to speak.

It wasn't until I began to see the recruitment efforts in the 1970s of people like Nichelle Nichols, television's Lt. Uhura on *Star Trek*, that I realized how committed NASA was to diversifying the astronaut corps and really taking the shuttle program in a whole new direction.

It was while I was a test pilot at the Naval Air Test Center at Patuxent River, Md., that I met the late, great Dr. Ronald McNair, who convinced me that I needed to apply to the astronaut program. My very strong, logical case for not applying was simply that I didn't think I would get in. Ron made short work of that argument when he told me that was the dumbest thing he'd ever heard, and of course the rest is history. We lost Ron on *Challenger*, but his influence on my life continues.

Certainly, traveling to space has changed my life.

I think we travel to space not only because it is human nature to explore, but also because it's our nature to expand the number of places we can live – to expand the reach of the human race.

We've now effectively extended our biosphere to space, and there hasn't been a time in the past 11 years when all of us have been on the planet at the same time.

That's pretty amazing, but it also gives us a responsibility to do more than take fantastic pictures or awe people with the smoke and flames of a launch, as spectacular as those may be. NASA has one of the most dedicated workforces around and we're on a mission. Not just the specific one at hand, but a mission to uncover new knowledge so what we learn and do can benefit all human kind.

My time in space taught me many things, but even before the space station was constructed, our exploration efforts, from Apollo-Soyuz, to Shuttle-Mir and shuttle missions with international crews, were teaching us how to be global citizens. Space exploration is something we do as nations, together. We don't always have the same goals up there, but we can do it all peacefully.

I was privileged to command the first shuttle mission with a Russian Cosmonaut aboard, and I confess that it was humbling and not initially inviting for me to face my preconceptions of what it would be like to work with someone who was, ostensibly, at one time my enemy. But when you live and train with someone for two years and get to know their family, well, let's just say it's hard to look at them the same way again. That man, Sergei Krikalev, and his family have become life-long friends to my family and me. Today he leads the Gagarin Cosmonaut Training Center outside Moscow in Russia.

So for me, space is not just a destination; it's not just something about which I can say, "I've been there – one of the lucky few." It encompasses a way of approaching our biggest problems – a way of looking at our world differently and thinking how to strive for our higher potential – how to work together as nations. While our space program began in competition, it has become now an international collaboration. Space is a uniter.

It's hard not to feel connected when you see our shared planet below looking fragile in the great blackness, but free of political boundaries, seeing only those created by nature such as rivers, oceans, and mountain ranges. If everyone could view our fragile world from space, they'd see how we're all in this life together on a marvelous globe that needs stewardship.

It changes you forever! It has made me want to dedicate my life to helping other people get there.

Today that door to space is opening wider. With the recent success of SpaceX, becoming the first entity outside of a government to successfully send a cargo capsule to the International Space Station and retrieve it intact, we're at the start of something new and big and really exciting. We're opening up an entirely new segment of the economy at the same time as we're making space more accessible; more a part of our daily lives than it ever has been before.

There are spaceports all around the world. A few right here in the U.S., and I believe that many more people will be taking to the stars in the future, as researchers, tourists, students, and representatives of a globally spacefaring people.

NASA received more than 6300 applications during our most recent call for astronauts earlier this year -- the second highest number ever, so I don't think interest in space has waned. The

young people I talk to around the world are passionate about our future. It's one of the things that gives me great hope -- to think that my granddaughters may witness the first humans on Mars or maybe even be among those pioneers themselves. I believe it's an attainable achievement in many of our lifetimes. With a President who has urged us to develop the technologies that will be required to get us there and a growing fascination with the accomplishments of NASA and its many partners in space, deep space exploration with humans is within our grasp.

When the *Curiosity* rover lands on Mars in August, it's going to be another incredible milestone.

I know here at Air and Space, one of the most popular things you had going after the Mars Exploration Rovers landed was the evolving display of the incredible images from those plucky little vehicles, and that same kind of excitement is going to happen again with *Curiosity*. It's going to visit a new place on the Martian

surface, a hard to reach place near a mountain range, and the arrival will demonstrate the precision landing technologies we'll need to land future missions on other planetary bodies.

Then we'll have this laboratory about the size of a small car roving around the planet with the most sophisticated suite of instruments ever sent to evaluate whether Mars might have ever been hospitable to life. Certainly, among the biggest questions mankind has ever considered are: are we alone – is there life elsewhere in the universe. They have captured the curiosity of humans for centuries.

At the same time as *Curiosity* sends back what is sure to be incredible data from Mars, we'll also still be orbiting Mercury and Saturn, and on our way to Jupiter and Pluto. Just two weeks ago we launched *NuSTAR*, a black hole spotter. *Kepler* has discovered hundreds of planets around stars in other solar systems and continues to do its work. *Hubble* keeps transforming

our view of cosmic phenomena and the James Webb Space Telescope, its successor, is preparing for a 2018 launch. That telescope's first instrument just arrived at the Goddard Space Flight Center a couple of weeks ago, and the project has been meeting its many structural, technical, and spending milestones. The Webb Telescope's launch will be a first as we send it to a point one million miles away from Earth on a hunt for light from the earliest days of our universe.

Right now many of our Earth scientists are gearing up for hurricane season. The *Aquarius* mission recently released the first map of global ocean salinity.

We certainly haven't lost sight of our home planet as we extend our reach throughout the solar system and look beyond it.

So today, there may be budget squabbles across the street in that big domed building. But at NASA we're still in the future

business, so we take the long view. When you're preparing an instrument to peer back billions of years, or developing the technology that will rocket humans at tens of thousands of miles an hour to destinations they've never before visited, or studying the mysteries of the sun and how it affects our planet – well, you can get lost in the magnitude of our work and today's problems may not seem like such a big deal.

It's been my great honor to be part of a mission that deployed *Hubble*, one of the greatest scientific instruments of all time, and to be part of a corps that flew an experimental vehicle – that incredible flying machine – for three decades, continually refining it and bringing into existence something that the world hadn't had before -- a reusable space vehicle, which some of our commercial partners will now also be developing. Because NASA pioneered such a thing, they can follow in our footsteps.

There are legacies like these all across our space program -- people and technologies. Among this nation's greatest legacies -- and legacies may be the wrong word, because we're not stopping any time soon -- these achievements represent the jump start we gave to a global exploration enterprise. These achievements helped turn what was a global competition into global cooperation. Today, we remain at the forefront as leader of this massive effort.

I was privileged to be at events earlier this year celebrating the 50th anniversary of John Glenn's first orbital flight, and he talks about how at each stage of the path, we learn something. The research is always important, and incorporating what we've done to make it to the next level will be critical. Enhancing our utilization of the International Space Station is one of his passions as well as one of mine. This is a challenge we must meet to enable realization of many of our exploration dreams and visions.

Today's space program is vital and alive. It is led by men and women who are passionately dedicated to space and keeping America the leader in its exploration and expanding John Glenn's legacy.

They're across this nation and around the world, working on the next phase of a global space exploration enterprise that those first astronauts and scientists and engineers and the many thousands of people who supported them helped to make possible.

It's been my honor to be a part of one of our nation's greatest successes and to help shepherd NASA to its next destinations.

There are many bright days ahead for the nation's space program, and for civilization's progress into space. I hope every one of you here tonight is as excited and passionate as am I about ensuring we realize every potential of our time.

My thanks again to the Smithsonian for this opportunity and for its role in the promotion of exploration and keeping the dream alive!

God bless each of you and may God bless the good ole USA!